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IMPORTANT

PLEASE NOTE

The President of the B.P.A. has requested the Wisconsin Chapter to assume the editorial responsibility of this volume. Because some members of this chapter are experienced, and because of our proximity to the publisher, the Wisconsin Chapter voted to accede to the President's wishes. An editorial staff was, therefore, appointed by the Executive Committee of this chapter. Until further notice all manuscripts and correspondence regarding the Journal should be sent to the following address:

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Photocopying: Technique and Preparation of Material*

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COPYING, the photography of two-dimensional objects, is an important part of biophotography. It is used to reproduce an original which is unique or valuable or to multiply the number or change the size of an original.

The following conditions must be met for good results:

The original must be so supported in front of the camera as to be parallel to the film to avoid distortion.

The original must be uniformly illuminated. Intensity of illumination should be sufficient to make exposure time reasonable.

The camera must have a long bellows extension so that more than life size copies may be made of small originals.

The negative emulsion must be appropriate for the characteristics of the original.

Equipment

Cameras equipped with ground glass focusing backs are the most satisfactory for copying and the best of these is the view camera. This camera has a great range of adjustments in addition to having a focusing screen. Its long bellows extension permits full size (1-1) or enlarged copies; movements of the lens board and swing-back enable fine corrections for centering the image and insuring the parallelism of lines.

Next best is the hand camera using sheet film and having a glass focusing screen at the back. Typical of these are the "Press" cameras, like the Speed Graphic, the Linhof and others. While not having too generous bellows extension, most of these instruments provide sufficient extension to make 1-1 reproductions. These cameras are usually focused by moving the lens. It is convenient to determine by measurements on the ground glass, the positions of the lens for various magnifications, and mark them on the camera bed. When the lens-film distance is twice the focal length the ratio will be 1-1.

The single lens reflex, such as the Graflex, is a satisfactory copy camera, especially the models with extra long bellows.

The precision miniature 35mm cameras *with detachable lens* can be adapted satisfactorily to copying by a ground glass screen attachment, such as the Speed-O-Copy which is available for most 35mm cameras with detachable lenses. A sliding focusing attachment and a rotating focusing attachment are made by the Leitz Co. for the Leica. The Eastman Flurolite Camera Assembly 35mm at-

*This is the first of a series of comprehensive articles, to be written by various authors, which will be published in the J.B.P.A. as a dedication to the late John Fallon, M.D. Dr. Fallon's untimely death on June 22, 1951 precluded the publication of a general Handbook of Medical Photography which he intended to edit. Much of the material to appear in this series was specifically prepared for that volume. See J.B.P.A. 19:140, 1951.

tachment also has a ground glass focusing screen.

The poorest camera for copying is the roll film camera with a permanently mounted lens and shutter. With the addition of a supplementary lens, these cameras can be used but the procedure is tedious. There is no surety of proper coverage of the subject as a large parallax exists between lens and finder when working close up. The only way the image can be checked is by removing the film, opening the back of the camera and inserting a ground glass in the film plane.

Most of the usual light sources can be used for copying. High intensity is not necessary. The important thing is to light uniformly. This is most easily done by placing one lamp on either side of the copy easel at an angle of 45° to the camera axis. Both lamps should be exactly the same distance away from the subject and of exactly the same intensity. When using photofloods, both lamps should have been in use the same length of time, because photofloods blacken rapidly with age.

There are two setups for copying by camera, horizontal and vertical. The simplest horizontal arrangement is to place the original material on a convenient wall, set the camera on a tripod in front of it and place a lamp on each side of the camera. More elaborate setups can be purchased or made. For example, on a sturdy, long, narrow table or bench, preferably at waist height, one can mount two strips of wood as a track upon which rides a platform for the camera. The easel for holding originals can be built on one end. The center of the easel must be in the camera-lens axis. Movable extension arms for lamps can be attached at the sides of the bench. Dimensions depend upon the available space and on the camera-lens combination used. Such an assembly should satisfy all the conditions mentioned earlier.

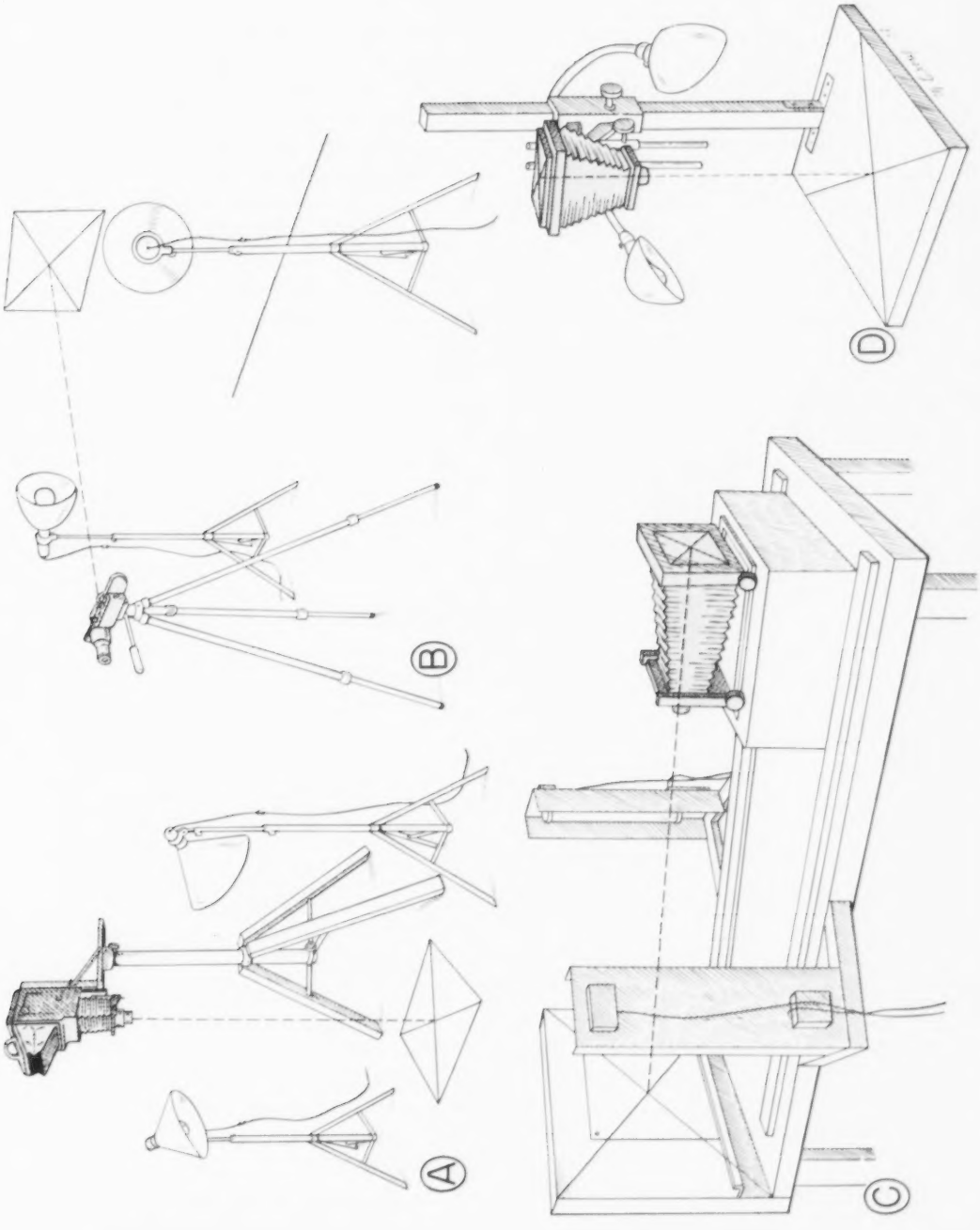
The vertical assembly in its simplest form is a camera on a tripod with a tilting head, tilted so that the lens points down to the object on the floor (90°). Lamps on each side provide illumination. As in the horizontal setup, refinements are possible. A track can be built, either attached to the wall or on a vertical frame for up and down movements. In recent years manufacturers of several enlargers have offered accessories that convert them into satisfactory copy cameras. The Kodak Flurolite and Burke and James Solar are typical of these. The accessories consist of a ground glass camera back which replaces the lamp house, a pair of lamp holders which fit on the vertical post and a shutter for timing the exposure.

For either setup, horizontal or vertical, the paramount requisite is stability, because exposure times may be long. Any looseness of construction which allows parts to come out of line must be corrected.

Technic

A simple way of aligning the lamps is to place a mirror the size of the original, or four small mirrors in the four corner positions occupied by the original, on the easel. Place the lamps in position at about 45° to the easel. Look through the camera and if the reflected images of the lamps are seen they must be moved to a lesser angle until their images disappear from the ground glass.

A quick check on the uniformity of illumination, particularly on large original material, is to use an exposure meter, scanning the top, middle and bottom of the original. Care must be taken that the shadow of the meter is not read. Another method for a quick check is to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hold a small card vertically on the center of the easel. The shadows cast by the card, one from each lamp, should be identical in size and density. Differences in size mean that the lamps are not at identical distances; differences in density of the shadow mean that lamp intensities are different.

Exposure is determined by the white card method when using meters of the reflecting light type. Incident light meters use another method. By the white card method, a standard white card is placed over the original and the reflected light is read by meter. The meter is held at a distance equal to the diagonal of the card and the exposure is calculated by using a "white card film speed" instead of the normal rating of the film (this is 1/5 of the normal rating).

When the distance from lens to easel is less than 8 times the focal length of the lens, the exposure time read from the meter must be converted. When the lens is extended to give a 1-1 image, the exposure is 4 times normal. For other values one can consult the Kodak Effective Lens Aperture Guide.

A quick focusing device is a target or scale, marked on the ground glass of the camera, which can be projected onto the original by a light behind the camera. When the target image is in focus on the original, the original will be in focus on the film.

The following accessories will be found helpful in copying: a small spirit level, some small wooden blocks and wedges for propping up books, some wide elastic bands for holding pages down, a roll of scotch tape, some push pins and a clock or watch with a sweep second hand.

Line and Continuous Tone Material

Objects for copying are of two main types: line or continuous tone. Line originals have only two tones—black and white. Examples are printed matter, charts, graphs, electrocardiograms and similar records, drawings and sketches made with pen and ink. Continuous tone originals contain shades of gray intermediate between the lightest and darkest tone: photographic prints, paintings and wash drawings are examples.

Both types are photographed in the same manner, but the negative emulsions used for each are entirely different. Line originals are copied with a short scale emulsion of the "process" type (See table 1). Care must be taken that the exposure is correct for this type of film, as it does not have as much latitude of exposure as longer scale films. The good process negative will have great density overall but the black lines in the original material will be registered as completely transparent in the negative. If shaded pen drawings are copied, the best results will be had by slight underexposure. If this is not done there is a tendency for the finest lines to fog over and they become very difficult to register on either print or lantern slide. Lighting of line copies must be just as carefully done as lighting glossy prints, because reflection can occur on the black India ink lines, particularly on broad black columns of a drawing. For the sake of flatness of the original, where columns are involved, it might be better to make the columns from black cellophane tape, as wet India ink causes the paper to shrink, unevenly, causing the paper to cockle. One can never get the original to lie flat after this happens.

Continuous tone originals are copied on a long scale film such as Ortho X, Commercial Ortho or Portrait. Great care must be used in lighting this type of copy material because of the danger of reflection. The exposure must be care-

TABLE 1.
SELECTION OF SENSITIVE MATERIAL FOR COPYING

Negative emulsions for black and white line material

Ansco
- Process Sheet film
- Reprolith, regular and thin base

Defender
- Process Ortho sheet film

Dupont
- Microcopy (35mm)
- Safety Positive (35mm)

Kodak
- Micro-File (35mm)
- Kodalith Film, Ortho and Pan
- Contrast Process Ortho sheet film
- Process plates

Negative emulsions for colored line material

Ansco
- Reprolith Ortho, regular and thin base

Defender
- Process Pan sheet film

Dupont
- Microcopy (35mm)

Kodak
- Micro-File (35mm)
- Contrast Process Pan sheet film
- Process panchromatic plates

Negative emulsions for continuous tone black and white material

Ansco
- Plenachrome roll film and packs
- Commercial and Commercial Ortho sheet film

Defender
- Portrait sheet film
- Commercial sheet film

Dupont
- Microcopy (35mm)

Kodak
- Verichrome roll film and pack
- Positive film (35mm)
- Commercial and Commercial Ortho sheet film and Ortho X sheet film
- 33 AH plates

Negative emulsions for black and white copy of continuous tone colored material

Ansco
- Isopan sheet film
- Supreme (35mm)

Defender
- Fine grain pan sheet film
- XF Pan sheet film

Dupont
- Superior-1 (35mm)
- Superior-2 (35mm)
- Microcopy (35mm)

Kodak
- Panatomic-X roll, pack 35mm sheet film and plates
- Plus-X 35mm, roll pack
- Portrait Pan sheet film
- Panchromatic plates
- Super Panchro Press—Type B

fully computed, as either over or under exposure will result in a reproduction which will not agree with the original.

Black and White Copying of Colored Originals

When the original is in color (with or without black and white also) an emulsion sensitive to the colors being reproduced is selected.

Tone values in the black and white reproduction of a colored original can be altered either by using color filters in conjunction with a color sensitive emulsion or by using a non-color-sensitive emulsion alone. This type of emulsion gives altered tone value because it is color blind. Without filters this material records red as black, blue as white, medium yellow as dark gray.

Color filters selectively absorb light. They only are used with color sensitive materials. In general, a filter lightens an object of its own color, darkens an object of complementary color. Not only can color values be altered, but single colors can be filtered out entirely. The Kodak Filter Test Chart and the Contrast Viewing Kodaguide help in choosing filter and film combinations.

Color Copying of Colored Originals

Full color transparencies can be made from color originals by using color film. Artificial light type of film should be employed with lamps of correct color temperature. For Ansco Color film and Ektachrome Type B 3200°K lamps are necessary; for Kodachrome Type A the photoflood. Daylight should be excluded from rooms in which color film is being exposed, because mixtures of daylight and artificial light give improper color rendition.

Black and White Copying of Color Transparencies

It is important to remember that color transparencies often are more contrasty than black and white negatives and care must be taken to make a soft, full scale negative. The negative can be made in the copy camera or by contact or projection printing, but projection offers the greatest flexibility and control. For projection, the transparency is placed in the negative carrier of the enlarger, emulsion side up, and focused on the easel to correct size. If the enlarger leaks white light, the leaks must be blocked. Use a cut out mask, black scotch masking tape or drape with a black cloth. A panchromatic emulsion of the kind recommended for continuous tone copies is used. The negative material is handled like projection paper except that a panchromatic safelight must be used or the work must be done in total darkness. Exposure is determined by test strips. Color filters can be used to alter tone values in the negative; dodging to hold back or intensify sections of the picture. Negatives made by projection are printed in the conventional manner, since the image is not transposed.

To make a negative by contact printing, the panchromatic film and color transparency are placed emulsion to emulsion and the exposure made through the color film. In making the paper print, negatives have to be printed with the film side towards the paper emulsion to prevent transposition of the image.

The copy camera can be used for making the negative if the color transparency is placed on an illuminator that contains a tungsten lamp. Some illuminators have gas filled lamps (cold light) that distort color values; this may or may not be of importance depending upon the individual transparency. It is a simple mat-

ter to construct a small box fitted with a tungsten lamp and opal glass. It should be adequately ventilated in the event that one wishes to use a photoflood lamp when making color duplicates by this method.

It is possible to use a photomicrographic camera to make enlarged negatives from 16mm cine film. A diffuse lightsource, such as an illuminator box, minimizes any scratches that may be present on either surface of the movie film: the light ordinarily used for photomicrography would exaggerate such scratches.

Monochrome copies of color transparencies also can be made without an intermediate negative directly on special paper, e.g., Kodak Direct Positive Paper and Gevaert Diaversal. The procedure is the same as that described for making the negative except that the special paper is used and its special developing procedure followed. It yields a poorer reproduction than the negative and print method.

Copying Without a Camera

Copying can be done without a camera, but only to the same size. Any No. 4 contrast grade of contact printing paper can be used, or Reflex paper made for this purpose can be used. The process is simple, rapid and economical. Copies can be made of all kinds of line originals and of many kinds of continuous tone originals. Hand written originals in pencil or ink reproduce successfully.

The equipment consists of a strong lightsource for making the exposure, a printing frame or sheet of glass large enough to hold the original in contact with the printing paper, and facilities for processing conventional photographic printing paper. A room with *subdued* artificial light is satisfactory for processing, so no darkroom is necessary.

There are two methods: transillumination and reflection. The choice depends on the kind of original material to be copied and the kind of reproduction desired. The more economical method, transillumination, can be used if the paper base of the original is thin and evenly textured, if the text is on only one side of the sheet and if a reversed tone reproduction is acceptable.

In this method, the original is put face down in the printing frame, a sheet of sensitive paper is placed on the back of the original (the emulsion being in contact with the paper base of the original), and then light is directed through the front of the printing frame. The distance of the frame from the light must be equal to or greater than the diagonal of the area being copied. Exposure is determined by test strips. The paper is developed as directed by the manufacturer. The reproduction reads correctly from left to right. If the tone-reversal is undesirable, a positive print can be made by repeating the process and printing through the negative to another sheet of sensitive paper.

The reflex method is used for originals which are too opaque to transilluminate or which are printed on both sides. The reflex method is so named because the exposing light passes through the base of the sensitized material, strikes the copy and is differentially reflected back toward the emulsion. Development produces a negative reflex copy, that is, the black on white original reproduces white on black and is laterally transposed (reading backward). To obtain the final reproduction which reads correctly and has the same tone relationship as the original, a positive is made from the negative copy.

The steps in the method are: the paper

is put in the printing frame with emulsion side away from, paper side against, the glass; the original is placed with its "face" in contact with the emulsion side of the paper; the back of the frame is closed and the exposure made through the front. Lights and exposure are as in the first method. Reflex paper is processed like conventional photo paper, following manufacturer's recommendations about developer and fixer. After the paper copy negative is dry, a reversed positive on paper is made in the printing frame.

In making copies of originals in bound volumes by the reflex method, it is necessary to alter the procedure because the original cannot be put into a printing frame. A sheet of heavy, flawless, glass is used instead of the frame. The original is laid flat and the paper placed face down upon it. The emulsion is kept in contact with the printed surface by the sheet of glass which is placed over the paper. Makers of photocopy equipment supply book holders which simplify copying bound material.

Copies can be made also by the diazo process, which is inexpensive and rapid. The paper contains a light-sensitive diazo compound and a phenol which can produce a dye when exposed to the action of an alkaline liquid or gas. During exposure to light, the diazo compound is destroyed in proportion to the amount of light which strikes it. Then the paper is treated with an alkali which causes the remaining diazo compound and phenol to form a dye image. The paper has a low degree of light sensitivity and does not require the use of a darkroom.

Diazo copies are 1:1 size and can be made by transmitted light or by the reflex method. Instead of a camera the copy equipment consists of a special light source and a special developing chamber. Small table models as well as large commercial units are available. Some of the better known are Ozalid* and Bruning.†

The Apeco Autostat** utilizes a new process. The original to be processed is placed face to face with a sheet of Autostat No. 1 paper and exposed to light for approximately 10 seconds in a contact copier. Next, the No. 1 sheet is placed face to face with a sheet of No. 2 paper and the two sheets fed into a processing unit from which they emerge in approximately 8 seconds. The sheets, which adhere to each other, are peeled apart and sheet No. 1 discarded. Sheet No. 2 is a facsimile copy of the original, reproducing black, white and varying shades of gray. The Autostat copy is ready for immediate use and requires no fixing, washing or drying. The entire process takes less than 45 seconds. Similar equipment will very likely be provided by other manufacturers.

Preparation of Material for Copying

When making charts or drawings which are to be photographed it is important to use correct materials; smooth white paper and black India ink. For graph paper, one should use the kinds with grid lines printed either in blue or red. Blue can be reproduced as a pale gray which does not intrude on the curves of the graph or can be eliminated by full exposure on color blind or contrast process Ortho film without a filter. Red can be eliminated entirely by a strong red filter and process Panchromatic film.

Lines, straight or curved, should be made with a ruling pen. If possible use a straight edge or French curve. For freehand lettering Speedball pens, available in many sizes, are satisfactory. Hand lettering, well done, makes a fin

*Ozalid Corp., Johnson City, N.Y.
†C. L. Bruning, New York City.
**American Photocopy Equipment, Chicago, Ill.

appearance but few persons can letter without a mechanical aid. Artist's supply stores sell good lettering aid outfits, such as the Leroy* and other less expensive stencils. The skill necessary to use the Leroy outfit can be developed within a reasonable time. The outfit consists of a template with alphabet and figures engraved on its surface and a scriber-pen employing the principle of the pantograph. Templates and pen points are available in various sizes. The use of an electric typewriter to provide lettering in various sizes has been described by Wolf.

The width of lines and spaces is of importance when copies of reduced size are to be made. For example, when a graph is reduced to 1/10 size the lines are only 1/10 of their original width. If the lines are too fine and too close together in the original they will merge into an indistinct blur in the reduced copy. Likewise, if the lines in the original vary in width, the difference will be exaggerated in the copy; some of the lines or portions of lines may even disappear. The importance of proper size of lettering and spacing has been emphasized by Hewitt and by Sage. Very helpful suggestions appear in two booklets that are available from the American Standards Assoc., 70 E. 45th St., New York 17, N.Y. (ASA Z15. 1-1932) and (ASA Z15. 3-1943).

A little time spent in cleaning original material before it is copied may save much time later. Smudges can be removed carefully with art gum; white spots can be retouched with spotting brush to blend with the background; other defects can be corrected when indicated.

Smooth opaque white paper laid under thin originals will give added whiteness resulting in more density in the negative. If printing on the reverse side of the original material is seen through the paper, one can minimize this by placing a sheet of black paper under the original. The printing on the reverse side then merges with the black paper and is not evident in the negative.

Sometimes a glossy photograph that is to be copied acts as a mirror and an image of the camera may be seen in the darker portions of the photograph. This can be circumvented by hiding the camera behind a black card that contains a small opening for the lens. The use of polarized light is of especial value when copying certain kinds of original material.

Photocopying

Photocopying is done in a camera using sensitive paper instead of film. A prism on the lens transposes the image so that, while the tones are reversed, the subject matter reads the correct way in the copy. The copies are often called Photostats but this is the trade name of only one brand of equipment. In addition to the Photostat, other well known equipment is Rectigraph* and Dexigraph†.

The usual photocopy camera is fitted with a copy holder, focusing scale and lightsource. The sensitive paper comes in long rolls or various sized sheets. Each exposure can be cut from the roll and then processed in a tray or, in some cameras, the exposed roll of paper travels continuously through solutions until processing is completed. Duplex models handle bound copy when both sides of a page must be copied. They use paper sensitized on both sides and produce an image on each side. Reduction or enlargement of the copy is possible. The

*Keuffel & Esser, New York City.

*Haloid Co.
†Remington Rand, Inc.

opy, which has reversed tones, can be rephotographed to obtain a facsimile of the original. Most of the cameras are quite large and expensive, but their use results in economy when the volume of work is large.

An inexpensive method for making smaller photocopies is to use enlarging paper in the film holder of an ordinary view camera. A first-surface mirror supported at 45° in front of the lens will transpose the image so the copy reads correctly. An ordinary mirror may be used if the secondary reflections are not objectionable.

Microfilming

Photographic reproduction of books, journals and records on motion picture film stock, either 35mm or 16mm, is a specialized industry. The technic variously is known as microphotography, microfilming or microcopying. Production units, made by several manufacturers, consist of a camera holding a large supply of film, copy holder, lighting unit and auxiliary equipment for high speed operation. Some units are completely automatic and material for copying simply is fed into a slot in the machine. Processing is by the methods of the motion picture industry. Film is projected in a microfilm reader, available in many libraries. Enlarged copies of individual frames can be made and are known as photoprints.

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Estimating Ash Content of Bone, Using Standardized Radiographs*

LOUIS A. FACTO, JOSEPH KASTELIC, and DAMON V. CATRON

Ag. Exp. Sta. Photo Lab. and the Department of Animal Husbandry, Iowa State College, Ames, Iowa*

IN terms of current advances in the field of photography, the opinion is expressed that the reproductibility of photographic observation is exact. In some instances photographs, by themselves, may be used in place of actual experience and specimens which due to one limitation or another are not available for continued laboratory observation. Some research workers use photographic techniques as an aid to research in this manner. However, the major use of photographic reproduction concerns itself with *recording* events for illustrative purposes. There are, though, direct applications of photographic techniques to certain types of observation which are becoming integral parts of scientific investigation.

One technique that is particularly valuable and unique to the photographic process is sensitometry. Many of the current advances in photographic research and production are based on this technique. Research endeavor in nuclear chemistry has encouraged the use of sensitometry in other areas of application. The well known "badges" worn by employees of plants using radioactive substances are examples of this. Sensitometric techniques are incorporated to estimate the dosages of radiation any individual employee may receive incidental to his work. Nevertheless, sensitometry has been sadly neglected in many areas of research endeavor where photographic analysis is possible and advantageous.

Estimating bone ash as a possible application of sensitometry

Among some recent studies which involved sensitometric analysis are those described by Mack[1,2]. The results of her investigations of the skeletal development of human beings were based upon analysis of bone density as measured from radiographic plates.

A similar application of sensitometry was the subject of the current investigation. The primary consideration in this study was to determine whether a relatively reliable measure of ash content in bone** could be estimated from x-ray plate analysis. Since it is inherently or manifestly impossible to control the numerous variables which attend the taking of radiographs of specimens, it was essential that a procedure be used which would permit valid comparisons of the results.

This investigation was conducted on bones of living young pigs. At five weeks of age the animals were sacrificed and further chemical determinations of these bones were made. The bones studied

*Journal Paper No. J-2875 of the Iowa Agricultural Experiment Station, Ames, Iowa. Project No. 81.

** Bone ash content, in this experiment, was calculated to a moisture and fat free basis.

Figure 1. The pigs shown here were fed a diet containing 0.10 percent phosphorus. One physiological effect of the low phosphorus diet is evident. At the age of about four and one half weeks, the pigs, even when prodded, were not able to stand for more than a few seconds. It was often noted during the course of the experiment that food and water had to be placed in front of the pigs when this stage was reached. In contrast, the animals on the ration containing 0.40 percent phosphorus appeared normal.

...re those associated with the principle structures of the left pelvic limb.

Two groups of five pigs each (average age about one week), selected on the basis of weight and thrift, were placed on rations which contained 0.10 and 0.40 percent phosphorus* respectively.

Radiographs of the bones of the limb of each pig were taken when they were placed on the rations and at weekly intervals thereafter, until they were five weeks of age. Figure 1 shows some of the animals, at five weeks of age, which served as subjects for this study.

A portable x-ray unit, as shown in figure 2, was used in this experiment in order to facilitate obtaining individual radiographs of the animals.

The most satisfactory conditions for taking x-ray pictures of these bones, using non-screen film and conventional developing procedures, was found after some preliminary trials to be as follows:

1. Exposure time: 3/4 second
2. Power through anode: 60 kv.p at 15 ma.
3. Tube to film distance: 25"

A modification of Mack's technique[2], for evaluating differences in relative densities of the exposed and developed plates not related to variations in the radio-opacity of the bones, was employed. A small aluminum step wedge

* Monocalcium phosphate

Figure 2. The portable x-ray unit as employed in this experiment is shown under conditions of actual use.

nsisting of ten steps, varying in thickness from 1 mm. to 18 mm. and numbered from one to ten starting at the thinnest step, was placed on the film with the specimen to be exposed as shown in gure 3. Figure 4 describes the relationhip, in terms of characteristic curves (Hurter and Driffield Curves)*, between lings of an exposed and deped plate, as determined by a Weston photographic analyzer (model 877), nd the thickness of the steps of the aluminum step wedge.

The standardization technique used to mpare exposed and processed radiographs was as follows. Characteristic urves representing the various steps of the step wedge were drawn on semi-log graph paper for each picture. A hypothetical characteristic curve, which was representative of other curves in the experiment, is presented in figure 4 as a dotted line. This curve was the result of the use of a "newer" developer, or it may represent prolonged development of the x-ray plate exposed as previously specified. A standardization of densities of the hypothetical characteristic curve can be achieved by adjusting the densities to another characteristic curve which is used as a standard. This curve is presented as a solid line in figure 4. The density of the second step of the aluminum step wedge on the solid line curve is equal to 1.7. By using graphic interpolation, point A, representing the density of the 2nd step, with a density reading of 1.96 will be found to correspond to the 1.7 density reading as shown by point A'. Other points may be interpolated in the

* Miller refers to this relationship as a characteristic curve.

Figure 3. A close-up showing placement of necessary components. The step wedge is placed close to the area of interest. A piece of string is attached to the foot to immobilize the limb and hold it straight. It also affords additional safety from stray irradiation to the operator. Notice the use of lead gloves as a safeguard to the assistant and as a more direct means of restraining the pig.

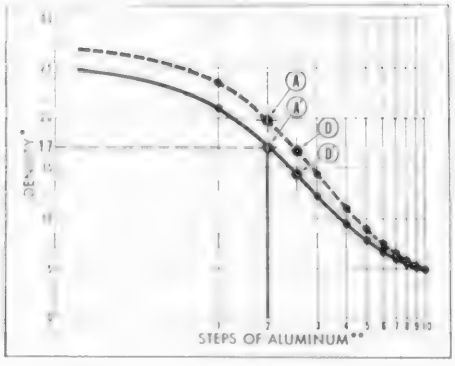


Figure 4. Relationship of the resulting densities from two non-screen x-ray films exposed identically under the aluminum step wedge and processed under different developing and fixing conditions.

*As indicated by Weston photographic analyzer model 8
**See text

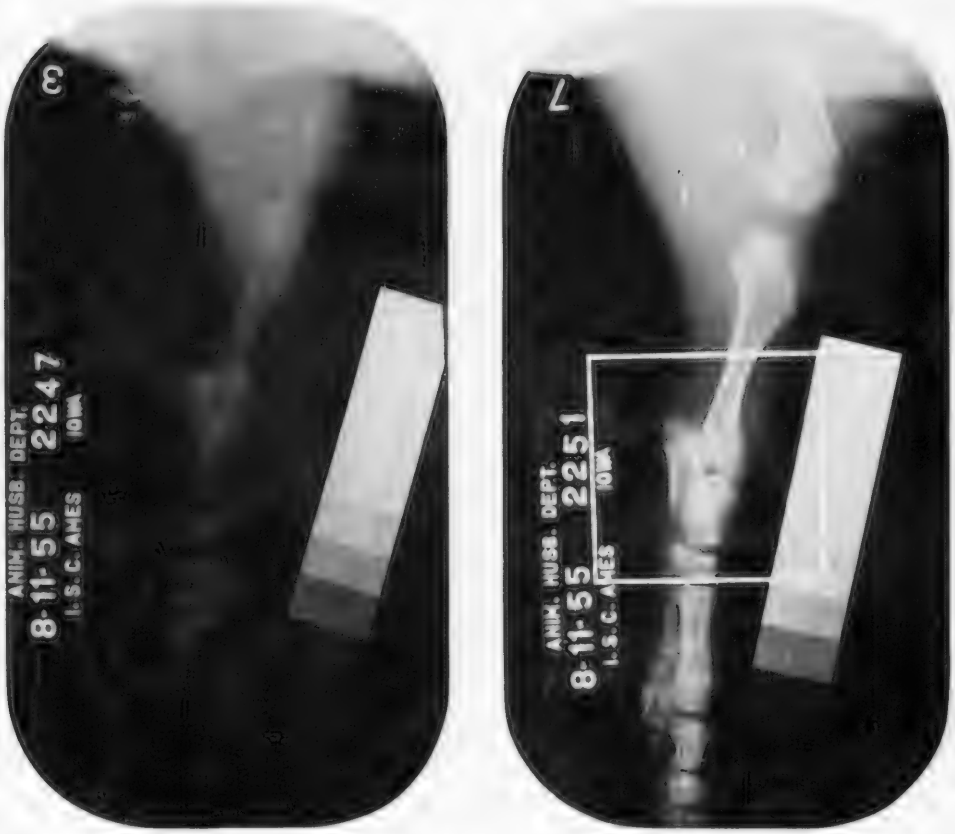


Figure 5. Differences in results of x-ray plates of the bones of pigs aged five weeks, fed different rations. The pig on the left was fed a diet containing 0.10 percent phosphorus and the pig on the right, a diet containing 0.40 percent phosphorus.

Figure 6. A close-up showing the area enclosed in the white square of figure 5. The position of the fibular tarsal bone illustrates the advantages of obtaining uncomplicated x-ray pictures since this bone is not buried in very much soft tissue. Neither are the radiographs complicated by the presence of other bones lying over or under this bony tissue. The tuber calcis of the fibular tarsal bone is identified by D_1, and D_2 represents the constricted part of the body of the fibular tarsal bone.

same way, e.g., another point, D, with a density of 1.65 is projected to point D′ with a resulting standardized density of 1.44.

Figure 5 illustrates differences in the results of x-ray plates of the bones of two young pigs. The differences in density of the image, of corresponding steps of the aluminum step wedge placed near the specimens at time of exposure, were standardized by this technique. Such differences in the density readings for the step wedge were taken into account when the density readings for the x-ray plates of the bones were corrected. This method provided the means which permitted direct comparisons of results for bones from various pigs, despite the fact that the radiographs may have been taken at different ages and processed under different conditions.

Preliminary consideration of relating the values for bone density with bone ash content necessitated investigations to determine which bone or bones would provide the most consistent data. Figure 6 is an enlargement of the area of the limb outlined within the white square in figure 5. Areas of bone tissue designated as D_1 and D_2 were selected for study because uncomplicated radiographs could be obtained for these areas. Comparison of repeated densitometric evaluation of x-ray plates of the areas D_1 and D_2 showed that readings for D_1 could be made which were more consistent than those for D_2.

A formula for this index is expressed as:

$$\text{Bone density index} = \left[\binom{a+b+c}{3} D_1\right]$$

where a, b, and c equal the density readings determined at the respective points as shown in figure 6, and D_1 equals the density reading through the tuber calcis of the fibular tarsal bone.

In relating the bone density index to the ash content for lots of pigs the above formula was modified to the following generalization:

$$\text{Bone density index}_n = \frac{1}{n} \sum_{i=1}^{n} \left[\binom{a_i+b_i+c_i}{3} D_{1_i}\right]$$

where n corresponds to number of pigs in each lot and i represents individual pigs.

In the live animal an additional limiting factor is encountered. This factor concerns itself with the effect of flesh on the density reading of bone. Density readings were taken at points a, b, and c, figure 6, in an attempt to correct for this factor.

In order to derive a bone density index to be correlated with actual bone ash content, the density of point D_1 was subtracted from the average density of points a, b, and c.

The above method for deriving bone density indexes is based on the assumption that:

1. The magnitude of bone density index differences is maximized.
2. The effect of small differences of bone or leg size is minimized.
3. The flesh density, except for slight density variations due to unusual x-ray scatter effects, and water and fat concentrations in this tissue, which vary inversely with the radio-opacity of the enclosed bones, provides a base of reference for comparing differences in bone densities.

The femur had been used in earlier nutrition experiments to chemically determine bone ash content, but the error factor associated with the flesh in the limb of the live animal was so large that the results derived from x-ray analysis were difficult to appraise. An analysis

of x-ray plates of the tibia would be excellent except for the superimposition of the fibula. Therefore, for the sake of comparative evaluation in terms of past experiments, a comparison of the actual ash content of the femur and the fibular tarsal bone had to be made.

It was also found that errors due to slight differences in current to the x-ray tube anode, or differences in exposure times, could not be corrected as was originally assumed, even though the various plates were standardized to developing and fixing differences. Too, a change in peak kilovoltage to the anode of the x-ray tube introduced errors that could not be corrected. These effects were verified by analysis of preliminary plates and comparisons of two plates where the exposure of one was known to be excessive. Throughout the experiment the variance of these conditions was minimized by all available control, but some error of the final results may be attributed to these sources.

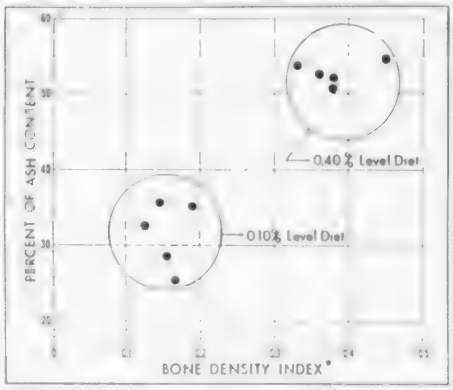
Results

The results of the chemical ash analysis of the femur and fibular tarsal bones revealed that the ash content of these bones was similar, as indicated by statistical analysis of the data. This makes it possible to compare bone ash content of the fibular tarsal bone by radiographic determination with the actual bone ash content of the femur.

The purpose of this study was to investigate the reliability and validity of the hypothesis that the bone density indexes of the fibular tarsal bone show a correlation with actual ash content of the bone.

The relationship between bone density indexes of the fibular tarsal bones, determined from x-ray plates taken immediately prior to slaughter, and bone ash content of the fibular tarsal bones, obtained from the animals when they were sacrificed, at age five weeks, is shown in figure 7.

The average bone density index of the bones of pigs on the 0.10 percent level diet was 0.15 and reflects an average



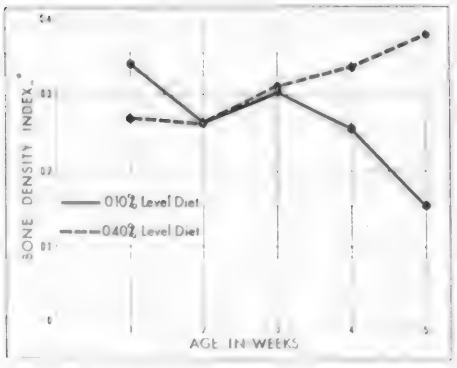
*See text.

Figure 7. The ash contents of the fibular tarsal bones plotted against standardized bone density indexes.

bone ash content of 31.5 percent. On the other hand the average bone density index for bones of pigs on the 0.40 percent level diet was 0.38 reflecting an average bone ash content of 52.5 percent.

The average of the bone density indexes within [illegible] from the radiographs at weekly [illegible] when the pigs were one week of age are shown in figure 8. It may be noted that the values for bone density, for bones of pigs on 0.10 percent phosphorus ration, decreased over the period under investigation, whereas, the values for the density of bones of animals on the 0.40 percent phosphorus ration increased during the period.

The data shows that there was little consistent change in the bone density of pigs on the two rations during the first two weeks after the animals were



* See text

Figure 8. The trends portrayed by average bone density indexes, derived from radiographs, of the two lots of pigs during the course of the experiment.

placed on experiment. It is apparent, however, that in the period from the third week to the fifth week there was a marked divergence in the respective values for bone density. The fact that the animals on the low phosphorus ration, during this period, showed symptoms of phosphorus deficiency, as portrayed by their failure to stand and to walk, indicates that the decrease in bone density may be regarded as a measure or abnormal bone development. However, it is stressed that there are no available actual bone ash content determinations for young pigs of ages one, two, three and four weeks and, therefore, the marked divergence of bone radio-opacity after the age of three weeks may be influenced by other undetermined factors concerning transmission of x-rays through bony structures of animals at different ages.

The result of this observation emphasizes the need for further study of factors which influence bone density values as they may be calculated from x-ray plates of bone, but does not preclude the use of x-ray techniques in this type of investigation.

The density indexes derived for the ash content of bone for pigs five weeks of age are in agreement with the bone ash content determination for pigs of the same age by Combs[4].

Summary

Radiographs taken under standardized conditions were made of bones of the left pelvic limbs of young pigs in an endeavor to determine whether differences in density of the exposed and developed plates could be related to differences in the ash content of bone.

Two lots of one week old pigs were placed on rations containing 0.10 and 0.40 percent phosphorus respectively. The animals were maintained on these rations for a period of four weeks. Bone density readings were obtained at weekly intervals and bone ash determinations were made when animals were slaughtered at the age of five weeks.

The bone density values, and bone ash content of the fibular tarsal bones, determined at the end of a four week experimental period, were found to be positively related. Young pigs fed a low phosphorus ration had bones which gave low bone density index values and low ash values. Pigs fed phosphorus adequate rations, in contrast, had bones which gave higher bone density index values and had higher ash contents.

Bone density index readings for bones of the animals, obtained at weekly intervals, showed that the transparency of the bones to x-rays increased in phosphorus deficient pigs during the last two weeks of the experiment, but was decreased in animals on the phosphorus adequate ration.

Problems which attend the use of the x-ray evaluation technique for *in vivo* investigation of bones of animals fed rations

adequate and deficient in phosphorus are discussed.

The foregoing investigations are preliminary and inconclusive, however, they do show that radiographs of bones of live animals may serve as a basis for evaluating variations in skeletal development.

ACKNOWLEDGMENTS

Grateful acknowledgment is given to L. N. Hazel and K. P. Bovard for their assistance in providing the equipment used in these investigations, and to Gordon Ashton who conducted the statistical analysis of the bone ash data.

The authors are also pleased to acknowledge the assistance of Don Funk, Mrs. Evelyn Robbins, and Mrs. Ida May Anderson in the collection of the data.

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ABSTRACTS

Some Aspects of Training in Medical and Biological Photography. I. A. Fairfax-Fozzard. Proc. Roy. Phot. Soc. Centenary Intern. Confer. on the Science and Applications of Photography, London, Sept. 19-25, 1953. R. S. Schultze (*editor*), Roy. Phot. Soc., London, 1955, pp. 619-21. The purpose of this paper is to present a brief survey of the present situation of photographic training in hospitals and in universities. Comment is made upon the increasing demand for greater skill on the part of the university technician and medical photographer; upon the standards and requirements of training; upon the problems of training; upon the suitability of the individual for this type of work; whether it should be done by an amateur or a professional; and finally upon the necessity for some form of higher education in photography.

Training in Photography. S. J. Coleman. Proc. Roy. Phot. Soc. Centenary Intern. Confer. on the Science and Applications of Photography, London, Sept. 19-25, 1953, R. S. Schultze (*editor*), Roy. Phot. Soc., London, 1955, pp. 607-10. The following aspects of training in photography are discussed: suitability of candidates; educational background necessary; methods of instruction (apprenticeship, part-time day release, evening classes, correspondence courses, full-time day courses at recognized schools); length of training; various subjects covered by courses, including color; examinations: preliminary Inst. of Brit. Photographers', Intermediate I.B.P. and C. and G. (City and Guilds of London), Final I.B.P. and C. and G.; list of schools: full-time day, part-time day, and/or evening; London School of Medical Photography.

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Journal of the Biological Photographic Association Vol. 24, No. 1 February, 1956

Illustrative Parasitology

WALTER PETANA

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PARASITES are living creatures which for a great part of, or for their whole life, live on or inside other living creatures - their hosts. For zoological classification most parasites may be placed into three groups, viz., Protozoa (or unicellular organisms), Helminths (the worms), and Arthropods (insects, ticks, mites). Many of the parasites are of great importance to both human and veterinary medicine because of the damage they are able to cause to their hosts. Social and economic conditions in some countries are also greatly handicapped by the prevalence of parasitic infestations in the human population and in domestic animals. The part the yellow fever carrying mosquito played during the construction of the Panama canal is well remembered, as also are the epidemics of plague in the Middle Ages, which were transmitted by infected fleas. The once flourishing sheep farming in Bohemia in the 17th Century became extinct due to infestation of the sheep by the sheep liver fluke.

An important factor in the fight against parasitic diseases is the exact morphological recognition of the individual species as well as knowledge of their life cycle, host adaptability and geographical distribution. Nearly every faculty of medicine has its own parasitology laboratories or institutes serving not only for diagnosis but also for the training of students. As already mentioned[1] proper recognition of parasites is a major step in the successful fight against them, and therefore, it is essential to demonstrate the various species in a natural state. The technique of preparation and preservation of parasitological specimens is of the utmost importance for their final presentation. Fixatives play a significant part in these processes.

Many of the specimens in the collections of parasitological institutions are unique and some are irreplaceable. The best and simplest way of demonstrating and permanently displaying such specimens is to have them recorded by photography.

General Technique

Photographic reproduction and recording of parasitological specimens is basically the same as in any other branch of medical and biological photography. One great advantage worth mentioning, is the fact that there is no special need for the use of color sensitive materials since the classification of parasitological specimens is done mainly by their morphology and not by cytological differentiation.

Briefly, the technique for photographing the various parasites is as follows.

For mounted and stained specimens a bellows camera with a triple extension is quite sufficient. For photomicrography, however, an appropriate instrument must be used, such as a single lens roll film reflex camera with interchangeable lens-

extension tubes and microscope adapter. These are ideal for all-round work and the operational cost is much cheaper than plate or single cut-film cameras. The choice of sensitive material is of great importance as most work in parasitology requires the use of filters, the choice of which is determined by the color of the specimen and the emulsion to be used. From the writer's experience orthochromatic material gives very good results with regard to definition and contrast as well as having sufficiently fine grain, providing a suitable developer has been used. It is advisable when photographing with orthochromatic films, even for unstained specimens, to use a light yellow-green compensating filter. For the photography of living specimens which are in constant motion, a fast panchromatic emulsion is preferable. Large worms are best photographed submerged in a suitable fluid medium in a glass dish with a blackened bottom. This eliminates distortions due to reflection. As a source of illumination either photofloods or "bounced" flash may be used.

Slides of mounted and stained large helminths are placed over a window cut in the middle of a piece of plywood. This arrangement allows the light to transilluminate the specimen, which then has the appearance of a colored transparency. All other light which may interfere during the exposure is cut out by the shield of plywood. The source of illumination, placed behind the slide with the specimen, is an opal 100 watt tungsten lamp.

Filters

Choice of filters depends on the density and color of the actual specimen. For example, a specimen stained by the borax carmine method will require the use of a green filter with orthochromatic material, or a blue filter with panchromatic emulsion. Specimens stained with haematoxylin and differentiated in acid alcohol will require a very light green or pale blue filter, owing to the fact that these specimens, as a rule, are stained deeper than those stained with borax carmine.

Special Techniques

Specimens of very small helminths are best photographed through the microscope. In general all small nematodes, and the larvae and ova of any helminths, are best photographed after staining with Lugol's iodine, the technique of which has been described in an article in a previous issue of this Journal[1].

Histological sections from various organs harboring parasites will require a combination of various types of objectives and eyepieces, the choice of which is dependent on the field intended to be included in the photograph.

General Considerations

In general, photomicrographs and photographs of parasites for demonstration, permanent display, or publication must show clearly the prominent characteristics which the various species are known to possess. Specimens which in any way have been damaged are not only useless but misleading.

There is no great demand for photography of insects in the field of parasitology, since most institutions prefer large scale models of insects on which it is easier to demonstrate their various characteristics. Very useful, however, are photomicrographs of various parts of insects showing certain peculiarities, an example of which is shown in Fig. 1. In general, the photomicrography of insects may be confidently attempted by even the less experienced photographer

as most of the work is done in the zone of relatively small magnification.

Figure 1. Photomacrograph showing lateral view of a flea

Microparasites

Finally a few words about the photomicrography of the smallest parasites of which the Plasmodium of malaria and the Trypanosoma of sleeping sickness are examples. The minute size of these parasites requires the employment of first class apparatus and technique in order to achieve satisfactory results. Oil immersion objectives, in conjunction with flatfield eyepieces, as well as provision for critical focusing are essential. With regard to the type of illumination, Koehler's method is most satisfactory and desirable for this kind of work.

These are only a few of the many requirements for high power photomicrography. Space does not permit the discussion in detail of the various problems and factors involved. Interested readers, however, should not find it difficult to obtain the required information from some of the textbooks which deal with the subject in detail.

The photographic recording of parasites is not only fascinating, but greatly simplifies the presentation of the parasites in the lecturing theatre.

Acknowledgments

The author wishes to thank Dr. G. B. Manning, Director of the laboratories where this work was compiled, for his great help in preparing and checking the manuscript. Further thanks are due to Professor R. M. Gordon, Head of the Department of Entomology and Parasitology at the School of Tropical Medicine at Liverpool, for the loan of specimens from which many of the illustrations accompanying this article have been made.

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Committee Members

Time-Lapse, Phase Contrast Cine Photomicrography of Tissue Culture Cells

N. I. KRAMIS

U.S. Department of Health, Education, and Welfare Public Health Service, National Institutes of Health Laboratory of Allergy and Infectious Diseases Physical Sciences Laboratory Headflow Mountain

A [illegible] phase contrast [illegible] filming as an aid in research on the effects [illegible] below. The major components are [illegible] rted phase contrast microscope enclosed in [illegible] controlled temperature incubator, and a 16mm motion picture camera triggered by time-lapse controls. The pertinent feature of the [illegible] is the inverted phase contrast [illegible] in which the subject is illuminated from above and observed from below. This arrangement makes it possible to bring the objective lens within working distance of co[illegible] row in the bottom of Carrel flask. Many of the items and accessories are [illegible] erally available in biological research la[illegible] tories and can be adapted for short t[illegible] projects. For more extensive projects similar etups, that lack no features for adaptabilit[illegible] and cost as much as $6500, have recently [illegible] ppeared on the market.

As shown in figure 1, the stand, m[illegible] body, and lamp housing are the essential part[illegible] of the Bausch and Lomb VH microproject[illegible] The focusing eyepiece is taken from the Leit[illegible] Micro-Ibso outfit and the camera is the [illegible] ersatile 16mm Cine-Kodak Special.

The 6 volt, 108 watt, ribbon filament [illegible] lamp is operated through a voltage stabilizer [illegible] table voltage control, and a 6 volt transformer for the lamp rating. The stabilizer [illegible] found necessary to overcome line voltage fluctuations, and the adjustable transformer [illegible] t possible to intensify or reduce [illegible] [illegible] is impossible to obtain desired exposure [illegible] [illegible]

A [illegible] merican Optical Compa[illegible] [illegible] and objectives were adapted to the inverte[illegible] [illegible] pe. Special long [illegible] [illegible] plied by American Optical are used [illegible] [illegible] [illegible] [illegible] A stage micrometer and the [illegible]

[illegible] control are operated outside the [illegible] [illegible] by extensions instead of the [illegible] [illegible] ble cables. These extensions are connected to the knurled knobs by rubber cups that were made from rubber stoppers (Fig. 2).

The incubator is constructed chiefly of [illegible] Plexiglas. The front and [illegible] [illegible] unit was [illegible] [illegible] [illegible] [illegible]

[illegible] camera is mounted on a 25-pound metal base which in turn rests on a rubber pad. The camera, with lens removed, is kept just clear of the focusing eyepiece. A black cloth [illegible] around the lower end of the [illegible] eyepiece and encircling the lens opening of the camera cuts out extraneous light.

Eastman's Electric Release and Control is employed to make the time exposures.* Time intervals are controlled with two synchronous motors with speeds of 1 and 10 rpm, respectively. Several 2" [illegible] are available for these. Predetermined numbers of equally spaced metal posts are screwed into the periphery of the pulleys. When the pulley [illegible] over a microswitch, closing the circuit at predetermined minute [illegible] intervals. The momentary closure triggers the release control for a time exposure, the duration of which is determined by the setting on the Control dial. For a 1 second interval, four posts are equally spaced on the pulley of a 1 rpm motor.

A Photovolt exposure meter is used. Illumination readings are taken from the reflex finder of the camera (the small finder magnifier [illegible] polished aside).

Eastman's Fine Grain Release Positive 730, 16mm film is used because of its fine grain and high contrast. Since the film can be processed under an OA safelight, the camera can be conveniently rethreaded after taking out exposed test strip.

A 20X phase objective was used for identification for the study of growth and the morphology of cells. This is the largest phase objective for which a condenser lens arrangement of at least 11mm working distance can be procured. The Carrel flasks are about 11mm thick. In case higher power objectives are used, thinner culture containers can be made from microscope slides, spacing rings and cover slips. For good phase contrast it is very important that the condenser be perfectly focused.

Most cultures are photographed for about 16 hours. Some of the intervals between exposures were 7, 15, 30, and 60 seconds. The exposure durations ranged from ½ to 4 seconds. These three time elements are, of course, governed by the nature of the subject and its rate of change or activity.

The film is processed in Eastman's D-16 for 9 minutes to get sufficient subject contrast. Since most of the runs on a culture do not expose more than 50 feet of film, processing is done in 3-gallon enameled pail.

The film is immersed in about 2½ gallons of the solution and agitated gently by working up and down, turning, and separating folds. Even development is achieved and emulsion abrasions are rare. Film lengths can be readily strung back and forth across a line for drying. The negative image is just as effective for projection and study as a positive one.

A 400-foot film, "Gross Morphological Changes in Virus Infected Cells," was made which shows the effects of polio, vaccinia, and APC viruses on monkey kidney and HeLa cancer cells. The value of fine grain 16mm

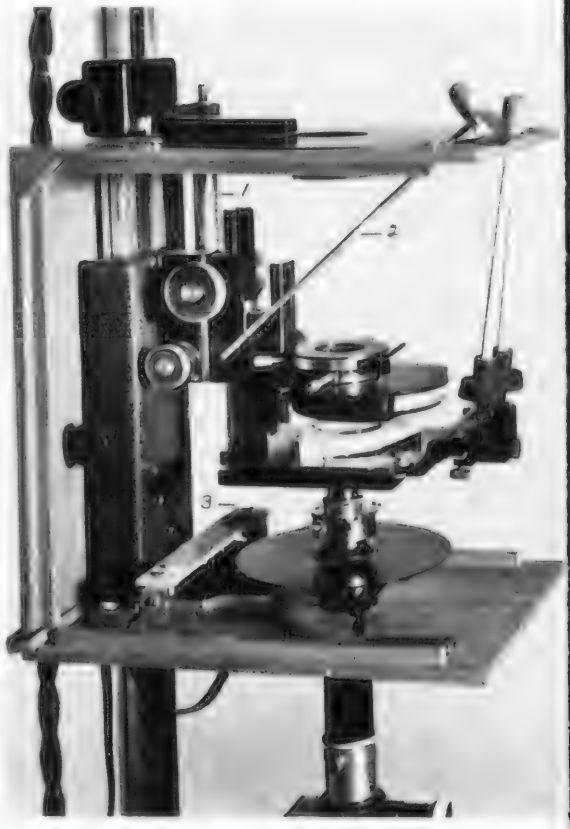


Figure 2. Closeup of the inverted phase contrast system and the incubator temperature controls. 1. Thermoswitch. 2. Thermometer. 3. Heating Element.

*Eastman also makes an Interval Timer to trigger the Release Control.

film is brought out by the good definition in the 4" x 5" prints that can be made (Fig. 3).

Equipment and technique for time-lapse cine photomicrography of tissue cultures have been described; the chief feature is an inverted phase contrast microscope. The technique makes it possible to record and study microbiologic phenomena without disturbance of cultures or other preparations which could alter results obtained.

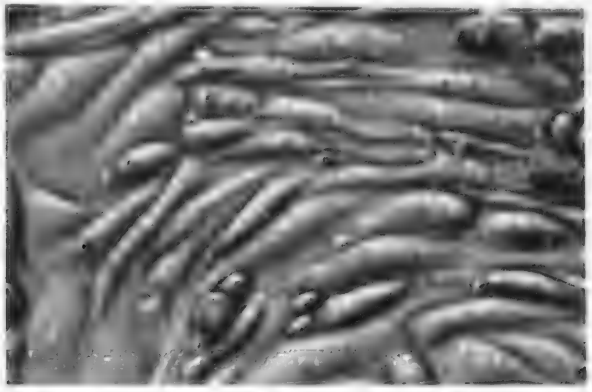


Figure 3. Enlargement from a 16 mm frame of fine grain motion picture film, showing virus infected monkey kidney cells.

The Role of Medical Illustration In the General Hospital*

JOSEPH M. LUBITZ, M.D.
Wood, Wisconsin

IT is perhaps appropriate that I, as a pathologist, have been selected to discuss the position of medical photography in the general hospital. Pathology and medical photography have both passed through similar stages of development. Both had their early beginnings in some inaccessible, otherwise unusable room, gradually moving to the most centralized portion of the hospital. Both originally were undertaken by individuals who expressed an interest in something beyond their assigned duties, which was done in addition to their regular work. As the position of both the pathologist and photographer became established on a more or less full-time basis, these were occupied by individuals who were apt to be somewhat different from the rest of the staff. Perhaps they were considered eccentric. As social misfits, not being able to mix with other people and patients, they were relegated to the basement or the attic. To this day, the medical profession often mistakes our precision, our zeal and our scientific or artistic characteristics as expressions of personal peculiarities.

We have even more in common. In the beginning of the field of medical photography in this country, because of the interest of the pathologist in the illustration, the photographer was often the pathologist or one of his technicians. Even today the photographer and the pathologist are a working unit, functioning together for the service of the patient and the doctor.

*Presented at Luncheon Meeting, Biological Photographic Association Convention, Milwaukee, Wisconsin, September 1, 1955. Received for publication October 5, 19

Because of this unity, and because for many [illegible] I have been in close association with [illegible]ical illustration, I have selected to discuss with you what I consider to be the present day functions of the medical illustration department in a general hospital.

There are four fields of activity for medical illustration: (1) teaching, (2) recording, (3) publication, and (4) exhibit.

TEACHING Teaching is by far the most important. Medical science, like any other natural science, is objective and is accustomed to describing its observations. The medical record of the physical examination is an objective description of the physician's findings. The gross specimen and the microscopic slide represent a portion of the patient which requires precise description. The photograph or the artist's sketch is another means of recording these findings. This may be a skin lesion, a specimen of a tumor, a photomicrograph of this tumor, or even a moving picture of a neurologic disorder. In teaching, whether to medical students, interns, residents or physicians, it is necessary to have available [illegible] This includes not only the classical cases but also the unusual ones. Obviously the patient or specimen are not always available, and the illustration may serve as a substitute for the original. The Kodachrome library has, to a large degree, replaced the gross specimen museum. A good photomicrograph is often far more effective than the usual inadequate projection of a histologic slide. In teaching surgery to medical students and physicians it is generally agreed that much time is wasted in the operating room. A good short movie picture tells the story quicker and more graphically. These are examples of how medical illustration has become a requisite today for teaching at all levels.

RECORDS Next in importance to the hospital are pictorial records. This may be helpful to the physician, the patient, or even in the court room. The physician treating a case may record the course of a skin lesion, or the healing of an irradiated tumor, or follow the various stages of plastic surgery. Even to the patient himself, photography may be useful. Thus the presentation of a photograph showing a mutilating face lesion before and after treatment may have tremendous psychologic value to him. In deforming arthritic conditions, the patient may observe in himself the results of prescribed exercise. Photographs may even serve as a guide for his home exercises. In the courts, a photograph of a body injury, or of a tumor in question may be the most direct and honest way of presenting the facts of the case to the judge and jury. Finally, today, with the large-scale use of x-rays, copies of these are frequently made by hospitals currently treating the case, of x-rays taken at another hospital. Such x-ray slides may also be valuable for teaching purposes.

PUBLICATIONS The scientist thrives by information gained from medical literature and strives to enrich the knowledge of his colleagues by his own contributions. Few papers are published in medical [illegible] do not require implementation by illustrations. A photograph of a specimen or of a patient, a copy of an x-ray, a sketch of an operation or a graph enrich and clearly illustrate the point that the author is making. One hears complaints that there are already too many journals and articles written. Let us remember that it is to the medical journals and not the text books that the physician today turns for the source of current medical information. It follows that with the added growth of medical knowledge there will be still more papers published, and more work ahead for medical illustration.

EXHIBITS As another form of postgraduate education, the local or national exhibit has become more important. This, you, as representatives of your profession, are more aware of than we are. Many physicians attend conventions, not for the lectures but for the exhibits. This is truly an area in which medical illustration is all important. As you know, exhibits are becoming more and more professional and commercial-like. I often regret as I see these fine photographs, that there is less and less demand for the good anatomic artist. In all, the exhibits can effectively and concisely tell a medical story and will continue to do so.

Medical illustration has grown to maturity. It has become an important segment of that group which assists the medical profession in getting the patient well and advancing medical science. It has good artists, craftsmen, scientists and spokesmen in its midst. Whenever a lantern slide is shown to a medical audience, or whenever an illustration appears in a medical journal, medical illustration has made its contribution.

The Armed Forces Library Collection of Medical Motion Pictures

THE Armed Forces Medical Library, which has served as the national library of the medical sciences for the past hundred years, has established a national repository and reference collection of medical motion pictures. The Library's program is concerned solely with the preservation and reference use of medical films; it is not concerned with the field of production, distribution, or evaluation. When it was determined, as the result of an extensive survey of the field, that no comprehensive collection of medical motion pictures for research and historical purposes was being developed in the United States, it was felt that the Armed Forces Medical Library should act in its role as the national medical library to form such a collection. Believing that the medical motion picture is simply another method of communicating medical knowledge, and that the same general policies of scope should apply to films as they do to book and journal collections, the Library began in 1954 an intensive effort to collect medical motion pictures from all sources and from all periods.

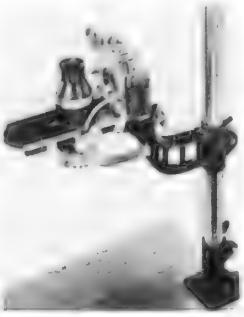
The ability of the camera to record visually fleeting phenomena was so obviously related to the requirements of medical science that medical motion pictures date from the earliest period of cinematography. Most of these medical landmarks in the new medium are lost beyond the possibility of recovery; many early medical motion pictures were issued in a small number of prints, shown until worn out and no longer projectionable, and then discarded. Other films are effectively lost to medical research because they are unknown and unavailable to the medical scholar. It is hoped that a large and integrated collection will enable medical motion pictures to take their place with other important primary materials for research in the medical sciences and the history of medicine. It is also hoped that the collection will be used by producers of medical film as a source of research material and that it will thus contribute to the improvement of medical motion picture technique.

An important feature of the Armed Forces Medical Library program is that it will meet the needs of individual research workers rather than those of group audiences. Medical films are now shown in the classroom, at meetings and conventions, and to specialized groups, but usually at set times for specific purposes. In this new repository of medical motion pictures, facilities will be furnished for the viewing of films by individuals who come to the Library, so that films may be used in the same manner as individuals now use the book collections. Catalog and reference service is to be provided. A compilation of available critical reviews and evaluations, together with all published material concerning medical motion pictures, whether or not prints are contained in the collection, will supplement the services provided by the repository of prints.

It is apparent that a program of this scope will be the work of many years and will require the cooperation of many people. The Armed Forces Medical Library is asking medical groups and associations, film producers, film libraries, and individuals to donate prints to this national repository of medical motion pictures. The Library is particularly desirous of acquiring obsolete films as they are withdrawn from circulation and before the print is beyond projection or copying. Those interested in medical research and the history of medicine and those interested in the motion picture as a medium for the communication of medical knowledge are asked to join the Armed Forces Medical Library in preventing the ultimate disappearance from the face of the earth of film documents of the utmost importance to medical research, medical education, and medical history. Communications on this subject will be welcomed by the Director, Armed Forces Medical Library, 7917 Thirteenth Street and Independence Avenue, S.W., Washington 25, D.C.

New Products

NIKON MACRO-COPY OUTFIT ANNOUNCED



availability of ... outfit ... for copying and macro-photogra... The Nikon Macro-Copy Outfit, as it will be called, is designed for use with ... doubles as the baseboard to which the base ... and focusing, the screen is directly over the ... in position. Two ... on the ... in pathology labs. Price of the complete ... separately and are individually priced. For complete information write to: Nikon Incor...

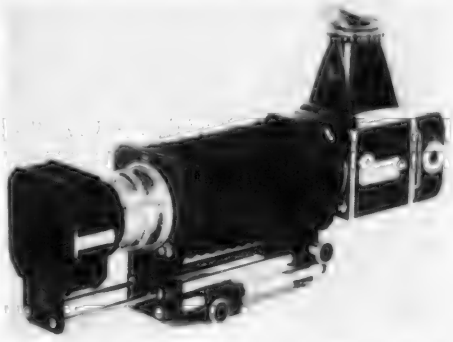
MILITARY CAMERA NOW AVAILABLE TO CIVILIAN PHOTOGRAPHERS

The Graphic "70" is probably the most a... curate photographic instrument ever built ... claim the manufacturers. Resolving power ... the camera, they state, is the highest ever ...

... in film cassettes, the 70mm film produces ... feet long. Using the camera's ... ter -- as many as 10 shots in six second... The three lenses are rapidly interchangeable ...

LEATHER BELLOWS FOR HASSELBLAD CAMERAS

Wholesale, American distributors of these cameras. This new bellows has a completely new type of graduated scale on the milled



tension tubes can be added which will ann- screws into the camera lens like a filter. This assembly fits any Hasselblad lens. Price

Wholesale, 111 W. 32nd St., New York 1, N.Y.

THIUMPH STANDARD

Standard Tripod. Locking braces between con-

any height. Its air pressure brake prevents

BRAUN ANTI-STATIC SOLUTION

laboratories, 296 South Hutchinson

cord to prevent "pinholes" resulting from dust

either 522 or 5

[illegible] It is priced as follows: Triumph Standard, $99.70; Standard Panhead (tilting 180° vertically), $16.50; Rex Panhead (tilting 180° [illegible]

KERN SWISS APO-REPRO LENSES

These distortion-free Apochromats of symmetrical design are corrected for all three colors [illegible] shows practically no variation at the different [illegible] usable at full aperture, although it is recommended [illegible]

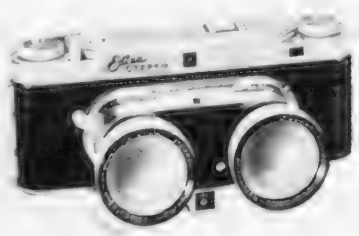
Kern Swiss Apo-Repro lenses are primarily [illegible] and color, but are also useful as objectives [illegible] for camera: Prices are: 210mm f/6.6 (8"), [illegible] 4 in. O. [illegible] f/5.3 [illegible]

NUMBERED STICK-ON TABS FOR "VARIGAM" FILTER SYSTEM

[illegible] contrast photographic paper, with its system [illegible] optical filter [illegible] insert a set of stick-on tabs which are numbered to correspond with [illegible] type tab, the No. 1 filter for "Varigam" i.e. [illegible] "Varigam" paper and its set of 10 durable optical [illegible] tabs are available from Du Pont Photo Products [illegible] ton 98, Delaware, for 10 cents. The tabs are supplied at no added cost with new sets of [illegible]

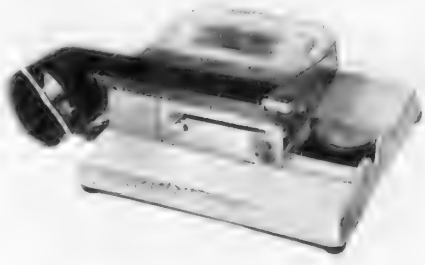
STEINHEIL STEREO WIDE ANGLE LENSES

[illegible] Steinheil [illegible] now producing wide angle lens units with a wide [illegible] teens and for the first time in photographic history, according to the manufacturer, "[illegible]



[illegible] is a compensating viewfinder which shows [illegible] viewfinder attaches to the base of the camera [illegible] is provided. Packed in a leather compartment case with shoulder strap, the price is $119.5[illegible] Swerdin, 705 Bronx River Road, Bronxville [illegible]

NEW 35MM FILM CUTTER



Known as the Bates Standard Film Cutter this new precision film cutter automatically

(Continued on page 43)

Your Association

A section of the Journal devoted to official announcements, chapter events, and other matters of historical significance to the Association.

The President's Page

One of the things your President has to do is report the actions of the Board of Governors and the progress of the Association. This has been done at the Annual Meeting and later published in a single issue of our Journal. However, our affairs are getting more complex so that it may be more practical to spread the report out over the year

* * *

Among the items that received much attention at the Board Meeting of April 21 was "certification". A few years ago the idea of certification for BPA members was first brought up at an Annual Business Meeting. The Board of Governors immediately started to consider the problem, but it turned out to be most complex. Also it came on top of Board commitments to revise the BPA Constitution and to look into the matter of finances. The BPA was growing rapidly and expanding in activity, so that a secretarial office had to be established. Printing costs were going up too. The recent raise in dues could not be set nor requested without considerable study

In spite of occupation with these problems, study on certification also went on We had a Certification Committee and an Educational Committee. To give you some idea of what is involved, the experience of the Registry of X-ray Technicians can be cited Please understand that their development is introduced here only as the most nearly parallel background for our guidance. The Registry is a fine thing and has bravely pioneered numerous problems. Their experience has helped, and is representative of other medical ancillaries

The Registry was first proposed in 1920, and was put into operation in 1923 Registrants were admitted by examination. By 1927, they reported "Only fair progress." There were financial problems, in spite of $10 initial fee and $1.50 renewals There were complaints that the entrance standards were "rather lax" and the exams stereotyped and unsatisfactory. They "drifted for six or seven years." Several legal problems of affiliation and responsibility also came up

Then in 1934 study of the educational requirements was begun and the Registry reorganized in 1935. Schools teaching the technicians were particularly under scrutiny. The requirements were made stricter and at least ten years intensive experience was needed in lieu of acceptable schooling. At one time, a year of college education was a requirement, but this proved impractical. There was still opposition to the Registry on the basis of unionism

Another appraisal of education was made in 1943. And the present successful system began to take shape at that time 23 years after the first proposal Sound education became and now is the keynote of this highly respected Registry.

With such experiences facing the Board of Governors of the BPA and similar and additional details like who and what to certify, it is natural that they did not care to jump into a certification program too soon. There is one big difference that should make us particularly cautious. The Registry was instituted by the Radiological Society of North America, not by the X-ray Technicians. On the other hand, *we* propose to institute certification of biophotographers. We have to be sure we know what we are doing and above all what we want. We can't start anything on unformed ideas. When we go to the interested institutions, we have got to have concrete proposals, not hazy wishes. We can't afford 23 years of experimentation.

Faced with enough problems like this to tax a full-time Board of a Philadelphia law firm, the BPA Board of Governors feels that the first thing we as an Association have to do is to establish standards of experience and education that serve to mark a competent medical photographer. We also have to encourage means for achieving this standard. We can then, if necessary, initiate an impartial Certifying Body composed of BPA members and individuals from groups concerned with the services of medical photographers.

There are two big advantages accruing from such a course: First, the BPA may not have to get into the complications of a certification program at all, at least not right away. The reason is that if means for giving suitable schooling or experience arise, and if they come up to the standards we set, then the mere presentation of proof of having partaken of such courses will constitute a form of certification. At least it will serve as a badge of competency for employer and employee. And this is the main purpose of a certification program anyhow. The other factor is that, should certification become necessary in the future after the first step, we would have had a firm basis for training already established, and thus could avoid many of the delaying pitfalls encountered by the pioneers in this field. Also, we might be able to work out a practical A.B.P.A. within our Fellowship structure to substantiate a desirable experience level. The educational background will be needed, too, and we will have worked out many of the details.

Therefore, the Standards Committee of the BPA is concentrating on the educational aspect. It and the Board can only serve the BPA fully if the members do some thinking too and send in suggestions and comments on how we can set up education and experience standards and how we can do something about various means for imparting the training.

Certification can affect only part of our varied Membership which comprises physicians, professors, directors of institutions and department heads, as well as photographers. Therefore, *services* on the interchange of ideas also receive much attention at the Board Meetings, because they affect everyone. More on this next time.

H. Lou Gibson

CHAPTER NEWS

L. B. Brown, Chairman, Chapters Committee

Boston: The Wright Co., photoengravers, invited the Boston Chapter to visit their plant in Cambridge on November 16. There was a conducted tour and a most interesting step by step illustration of what happens to our prints in the process of publication.

The January meeting was held at the Harvard School of Dental Medicine. The president of Photon, Inc. gave an illustrated lecture on the Photon Typesetting Machine. This fascinating machine is indeed a photographic Univac.

Ferd Harding, charter member and former president of our chapter made the famous picture of anesthesia of children using a teddy bear which you may have seen in Medical News or Time. The picture has been sent to England and South America and will appear in the yearly supplement to World Book Encyclopedia. A lot of mileage for one picture.

So. California: In November, at the Los Angeles County General Hospital the chapter was invited to attend a meeting describing the various techniques of photography for television.

In December the meeting was held at the Los Angeles County Museum when Maurice Mills of Hollywood conducted a Camera Clinic. Everyone was invited to bring in their equipment to be checked for inaccuracies. After holiday refreshments Sy Wexler showed two new Churchill-Wexler productions using time-lapse photography. "Plant Growth" and "Plants Make Food".

The January meeting was taken over by Don Harding of the Pasadena Police Department who arranged a tour through the new Los Angeles Police Building.

Chicago: The November meeting was held at the newly remodelled Photographic Department at Billings Hospital. There was a tour through the department and Mr. James B. Glaze spoke on "Simplified Color Exposure Determination".

The Annual Christmas Dinner was held on Tuesday, December 20, at the Illinois Union Building. There was a pre-dinner drink courtesy of the Chicago Chapter, and then roast beef. Two movies were shown after dinner. "The Cotton Tail", photographed by C. W. Schwartz, Biologist with the Missouri Conservation Commission, and "A Short Visit to the British West Indies", in color, by Morris Bleckman.

In January Mr. Ralph Greer led a discussion on material to be used in the forthcoming B.P.A. Chicago TV program, at the University of Illinois College of Medicine. Mr. Paul Holinger then demonstrated the Filmorama Lens which he used in recent travels with wide screen projection.

Central Indiana: We are very glad indeed to have a report from Central Indiana and thereby remove their name from the "not heard from for six months" list. A slate of officers was held at the first meeting of the season. President: George P. Cave. Vice President: Richard Scott. Secretary: Robert F. Albright. Treasurer: Paris Johnson. Meetings are held at the Indiana University Student Building and an informal supper in the cafeteria precedes the meeting. In November Dr. T. B. Noble was in charge of the program and in January H. Lieber Co., Color Lab., was host.

Officers of the Central Indiana Chapter, B.P.A. Seated, left to right are Robert F. Albright, Secretary; George P. Cave, President. Standing, left to right are Richard Scott, Vice President; Paris Johnson, Treasurer.

Upper Midwest: The Fall Scientific Session and Annual Business Meeting was held in Des Moines on November 12 and 13. Verlin Yamamoto was Chairman of the Scientific Session with the following program:

"Non-Medical Photography in a Medical Institution" by E. W. Miller, Mayo Clinic.

"Estimating Ash Content of Bone from Standardized Radiographs" by L. A. Facto, Iowa State College.

"Fluid Penetration between Fillings and Teeth Using Ca45" by J. K. Rothenberger, University of Minnesota.

Enlarged, Reduced, and Same Size Copies of Color Transparencies" by Stanley J. McComb, Mayo Clinic.

Resection of Abdominal Aortic Aneurysm" Drs. Britnall and Walker, by C. J. Deutch, V.A. Hospital Iowa City.

"Presentation and Discussion of New Kodak Color Print Material Type C and Type R" by D. V. Haptonstahl, Eastman Kodak.

There was a business meeting with election of officers for the forthcoming year: President: Lardner Coffey, Vice-President: Verlin Yamamoto, Secretary: Lynn Baldwin. During the business session the ladies were entertained by Mrs. Baldwin and Mrs. Yamamoto who gave a demonstration on "bon seki" or "tray scenery". The gentlemen joined the ladies after the business meeting for coffee and conversation.

New York: Many thanks to the New York Chapter who have contributed $50. toward outfitting the new office of our National Secretary.

Sam Dunton of the Bronx Zoo was the speaker at the November meeting at Cornell Medical College. Some of the material that many of us were fortunate enough to hear in Milwaukee was presented. This included two films: "High Speed Motion Picture Photography of a Rattlesnake's Strike" and "Introducing the Reptiles" with such fascinating shots as baby pythons hatching from the egg, etc.

The December meeting was held at the Color Lab. of the New York Institute of Photography. Mr. Joseph Russotti, teacher of natural color photography at New York Institute, gave a talk and demonstration on the making of separation negatives from a color

MEDICAL AND BIOLOGICAL ILLUSTRATION

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transparency and the making of a dye transfer print. This was a real "How to do it" talk.

In January the chapter welcomed Dr. Donaldson of Harvard Medical School who demonstrated his stereoscopic camera and lectured on problems of close-up stereo photography.

The Chapter's Committee is pleased to announce that two new chapters have been formed. Our total is now seventeen.

Capital Chapter: Headquarters of this chapter are in Washington, D.C. and the following officers have been elected: Dr. S. N. Sterg of the Naval Medical Research Institute, Chairman; Chester Reather of Johns Hopkins, Vice Chairman; A. S. Clarke of Naval Clinic, Secretary; G. M. Lowe of Diagnostic Radiology Unit, Treasurer.

The November meeting was held at the Armed Forces Institute of Pathology with Julius Halsman host. This was a business meeting and tour of the Institute's Medical Illustration Service. There were about 65 in attendance.

In December the group met at the Clinical Center of the National Institute of Health. Lt. Dittmore spoke on "Cinematography Under Difficulties", illustrated by color sound films made in Korea. Later there was a discussion of National Convention plans for 1958, Graham Eddy as Chairman. The program ended with a tour of the Photographic Center at National Institute of Health. Roy Perry host. The January meeting was held at the Naval Medical Center in Bethesda where John T. Stringer, Jr., Director of Medical Photography was host. Miss Dorothea Michaelson from the National Gallery of Art spoke on "The Anatomy of the Grotesque", and George W. Fried of American Optical discussed "The Principles of Interferometer Microscopy"

St. Lawrence Valley Chapter: Headquarters of this chapter are in Montreal with the following officers for 1955-56: Chairman: Charles P. Hodge, Montreal Neurological Institute,

Capital Chapter, B.P.A. Organizational meeting October 26, 1955.

Vice-Chairman: Jacques Renaud, Queen Mary Veterans Hospital, Secretary: Harold V. Green, Pulp and Paper Institute of Canada,

Officers and Guest of Honor at the Cornerstone Meeting of the St. Lawrence Valley Chapter, B.P.A. Left to right are: John Linder, Eleanor Sweezy, H. Lou Gibson, Harold V. Green, Charles P. Hodges, Jacques Renaud.

Treasurer: Eleanor Sweezy, Queen Mary Veterans Hospital, Officer: John Linder

The Cornerstone Meeting was held in November at Queen Mary Veterans Hospital in Montreal. Guest of Honor at this first meeting was H. Lou Gibson. Mr. Gibson gave a brief history of the B.P.A. and a talk on "Making the Scientific Subject Clean for the Camera".

[illegible] was held in January at the Montreal Neurological Institute. Eleanor Sweezy discussed "Photographs for Scientific Publications".

Wisconsin: During the year of 1955 the chapter members were busy with preparations and arrangements for the Annual Meeting in Milwaukee, Wisconsin. All the meetings held by the Chapter prior to the Annual Meeting in August September were restricted to details concerning the National Convention.

The election of officers was held during the [illegible] meeting at Marquette University School of Medicine. President: Edward A. Kresnik; Vice-president: Fred W. [illegible]; Secretary-Treasurer: Elizabeth Spuda. Following the business meeting Dr. Guy Kastler Tallmadge, Professor of the Department of the History of Medicine at Marquette University presented an interesting paper on "The History of Medical Illustration." This was followed by a get-together over refreshments supplied by the school.

The next meeting in January took place at Milwaukee Hospital, arranged by Robert Teevan who is in charge of the Medical Illustration Lab. in this hospital. Two papers highlighted this meeting. Anthony Kuzma, photographer at the Department of Pathology of Marquette Medical School presented an excellent paper, "A New Application in the Use of the Highlight Mask," which was published in the Journal of the BPA, Volume 23, Number 4. This was followed by a talk by Dr. C. Dix, a plastic surgeon, on "Photography as Related to the Plastic Surgeon." He presented his talk with illustrations made by himself and Robert Teevan. Naturaliy the usual refreshment period followed, sponsored by Milwaukee Hospital, in the usual Milwaukee tradition which enhances all Wisconsin Chapter meetings.

25th ANNUAL MEETING MILWAUKEE, WIS. 1955

1. Registration
2. Call to order Leo C. Massopust, General Chairman
3. Invocation The Reverend E. J. Drummond, S.J., Vice-president, Marquette University
4. Welcome John S. Hirschboeck M.D., Dean, Marquette U. School of Medicine
5. Welcome Michael Maradik, President, Wisconsin Chapter
6. 7. 8. Smorgasbord Guests of Pabst Brewing Co
9. Dr. Lester F. Flory, David Sarnoff Research Center
10. R.C.A. Color Television Camera

11. Brooks Memorial Union. Marquette University Luncheon
12. The Very Reverend Edward J. O'Donnell, S.J., President, Marquette University
13. The Reverend Clarence J. Ryan, S.J., Vice-president, Marquette University
14. Official B.P.A. Luncheon. Hotel Wisconsin
15. Eastman Kodak Co. Cocktail Hour
16. Annual Banquet. Past Presidents and speakers table
17. The 25th Anniversary cake

(Continued from page 34)

advances the film 8 perforations for ASA standard 2" x 2" double-frame size (24 x 36 mm) pictures. Other sizes may be cut manually by advancing film to frame line with lever on front plate. The product was designed by Dr. Harold Lutes for easier and faster film cutting. Film is inserted in long guides assuring square cut. Frame line is adjustable. Raising self-sharpening knife handle automatically transports film to precise width. Lowering knife handle cuts film "chip" to hairline accuracy. Easily cuts 40 to 60 "chips" per minute. Fingers do not touch film after it is inserted. Made of cast aluminum with wrinkle finish. Size 5½" x 6" x 2¼" high. One year warranty. Price $21.95 each at your local camera store or write Richard Manufacturing Co., 5914 Noble Ave., Van Nuys, California.

VIEWLEX SLIDE PROJECTOR

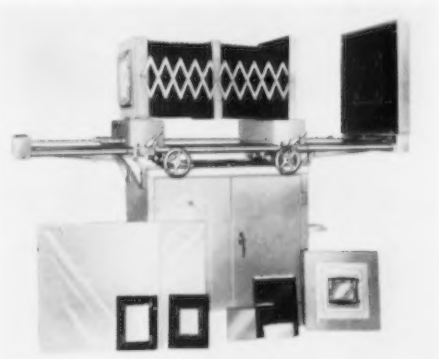
Viewlex, Inc., 35-01 Queens Blvd., L.I.C., N.Y., has introduced a new Project-O-Matic, 300 watt, motor fan cooled, automatic 2 x 2 and Bantam slide projector. It is constructed of all aluminum high pressure castings, and finished in a two-tone, hardened and baked, wrinkle finish. Projection of slides is full forward or reverse. When projection in sequence is desired, each slide is first moved into projection

position and then returned to its proper tray slot and the next slide automatically projected. A visual "slide selector window" is conveniently located for quick selection of any slide in the numbered trays.

The trays accommodate 30 slides in any type of mount, intermixed if desired. A built-in storage compartment houses an extra tray, making a total of 60 sildes filed with and ready for immediate projection. There is compact "tuck-away compartment" for the cordset, eliminating loose and dangling cords.

Equipped with a fast 5" Luxtar f/3.5 lens, the Project-O-Matic will also accommodate a 5" f/2.8 lens. A shutter, coupled with the automatic changing device eliminates all light on the screen between slides. Price, with 5" f/3.5 Luxtar lens, case and one tray, $59.95. The f/2.8 lens is available for $9.00 more.

BURKE AND JAMES PRINCETON CAMERA



An enlarging-reducing copying camera, available with film backs from 11" x 14" to 2¼" x 3¼", is available from Burke and James, Inc., 321 So. Wabash Ave., Chicago 4, Ill. The camera operates in either the horizontal or vertical position. Its specifications, applications, and accessories are so numerous, it is recommended that those interested should write to the suppliers for their 8-page technical bulletin. Price of the camera illustrated here, less lenses, is $1285.00.

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Members may propose for Fellowship in the BPA other members whom they consider worthy of recognition. To be eligible for Fellowship a candidate must have been a member of the Association for five consecutive years and must possess one or more of the following qualifications:

Superior craftsmanship in still or motion picture photography of biological subjects.

Ability in photographic research in new methods or materials.

(These require submission of evidence.)

Meritorious contributions to biological photography overall through sustained organizational work.

Two sponsors are required. The sponsors should be well acquainted with the candidate's work and ready to furnish the Board with details of his experience and achievements. Those who wish to sponsor a member whom they believe to be eligible should request a Fellowship Application form from the Secretary of the Fellowship Committee: Mrs. Maria Ikenberg, University of Illinois, 904 W. Adams Street, Chicago 7, Illinois.

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